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Possibilities of Home Work in General Science.[1]

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A few months ago while conversing with a teacher of English in a large city high school, I learned that she had directed her pupils to write a description of the domestic house cat from first hand information gained from the living subject. The following day the students apologized for not having prepared the descriptive theme according to the instructions given, because, after due search and diligent inquiry had been made, they had failed to locate this species of animal. The intent of this teacher of English was grand, life descriptions must be made from living subjects, but she failed to get such descriptions from her pupils for the very reason that she is living behind the time and advancement of our modern age. She should have known that in all well regulated city homes the cat has been strictly replaced by the simple spring mouse trap in much the same manner that the horse has been driven from our city streets by the automobile and auto truck. Furthermore she should have known that the pet of her maiden youth has become very unpopular as a carrier of disease, an element in the high cost of living, and in the teachings of Audubon societies, and for these reasons her pet in memory has been outlawed and consequently not commonly found in a well established and up to date community.

But what do you actually think of a teacher of general science who taught the construction and operation of a hot air furnace in the space of fifteen minutes, and who on the following day sprung a twenty minute quiz on his pupils to test their understanding of this heating and ventilating device? The teacher of English who desired a life description of the recently ancient cat is an artist and an up to the minute teacher compared with him. Her pupils did at least discover the scarcity of cats. What did his discover? Did they really dis-

[1] Presented at the Chicago meeting of the Central Association of Science and Mathematics Teachers, Nov. 29, 1919.

cover that a hot air furnace has an actual existence and a relationship in and with a fairly modern home? She had at least an actual project in mind and had sent her pupils forth on a happy quest to search and to learn from first hand experiences, but his went forth from a room actually ventilated with confusions and abstractions to return the following day to a bondage of classroom despotism to be examined on a superficial nothingness which, happily, was no part of them. I know that you are thinking that these illustrations are far and over drawn, perhaps they are, but they illustrate well the purpose of this paper.

The possibilities of home work during a course in general science depends wholly upon the attitude of the teacher who is handling the subject. If the course is limited to the mere dimensions of the classroom or laboratory of the particular building in which the teacher is offering instruction, there are no possibilities for home work in his general science course. On the other hand if the teacher realizes that of all the subjects offered today in our courses of secondary education that general science is the one subject that deals with the translation of the physical elements that make up the home and community life of man, he will find that there is abundant opportunity for a great deal of delightful and inspirational teaching which will send his pupils back into the home and community eager to experience and give expression to the elements and factors of their very lives that existed heretofore deep in the substratum of their consciousness. Failing to receive this directional teaching a child's subsconscious mind becomes a veritable grave yard of ideas and thoughts that might have found an expression in a living consciousness instead of passing into an accepted oblivion in which there is no analysis into "the why of things."

To insure the success of this kind of work in the class room and in the home the teacher must necessarily survey the "stock in store" of the average individual pupil that confronts him. He must acquaint himself with the amount and kind of nature study work, geography, physiology, elementary agriculture, manual training, and other elementary sciences and arts that have been taught to the child while climbing up through the grades. For today a lot of wholesome work is being done in

these pre-elementary sciences of the grades, and this work bears much the same relationship to the general science course that the sciences of the high school period bear to the early sciences of our universities and colleges. He must study the community in which the child has been reared and catalogue, so to speak, the experiences and daily phenomena with which the child is already acquainted in a more or less superficial way. Having made these surveys and catalogues of the elements and factors that make up "the stock in store" of his pupil the teacher must determine upon a course of projects which will lead his pupil into "the heart of things," a course of projects that are in themselves related and capable of an easy classification; a course of projects that leads the child's mind more or less consciously to see the relationship of things and events from the standpoint of cause and effect; a course of projects that aim to develop an attitude of observation that leads to conclusion of fact and principle.

In an endeavor to embody this spirit and mode of presentation in our general science course in the University-School at Cincinnati we have built the course about the following series of projects:

1. Lighting the home.
2. Heating the home.
3. Weather and climatic conditions about the home.
4. Building the home.
5. Clothing and feeding the individual of the home.
6. Communicating with the home.
7. The home and its relationship to the world's work.
8. Life and self improvement.

As you at once observe, we have emphasized the home element throughout the series of projects. The common criticism is that such a selection of projects narrows the field of general science, but such is not the case, and quite the contrary is true. Here, at least, we have no series of subjects on certain portions of chemistry, physics, biology, astronomy, earth science, physical geography, and physiology which have no relationship other than the buckram that binds the text in which such an arrangement is presented.

What does the first project, lighting the home, suggest to you? In order to develop this project we are led to take up

the following sub-projects which present themselves at once in a natural sequence; the discovery of fire and with it the primitive uses of heat and light; various primitive lighting methods such as the fire brands and the vessels of burning oil with and without wicks; the development of the candle; kerosene and the kerosene lamp; gasoline and the gasoline lamp and its need of a mantle; illuminating gas and gas lighting with its two types of lamps, jet and mantle; electric energy and the development of the filament and arc lamps; natural and artificial lighting; and direct and indirect lighting systems. These sub-projects, of course, suggest subsidiary projects and problems to which attention is necessarily called during the process of its development, and thus we see that each project becomes automatically a center of logical organization.

The project method of attack makes home work a possibility for the very reason that it incites the pupil to action rather than to inaction and reaction. Let us consider the project of lighting our home and here discuss a mode of attack or presentation for the first sub-project, the discovery of fire and its primitive uses. The actual discussion between teacher and pupil arises from the following considerations:

Was primitive man ever without fire?
How did he at first obtain fire?
Did he later learn to produce fire?
What were the methods of producing fire?
Did the American Indian use any of these methods for the production of fire?
How did the Pilgrim start his fires?
Have you ever started a fire by any of these methods?
Will you try and see if you can succeed?
Will you bring to class the articles and materials which you used in trying to produce fire whether you succeeded or whether you failed?
What effect did the discovery of fire have upon the life of primitive man?
Did he light his home?
Did he have a portable light?
Will you prepare some fire brands and bring them to the class?
Have you ever seen a picture of a Greek or a Roman lamp?

Describe its shape.
Can you name the materials of which it was made?
Name the oils used in these Greek or Roman lamps.
Why did they use a wick in these lamps?
What materials were used in manufacturing the wick?
Will you make such a lamp out of modeling clay and bring it to class ready for use?

Here we have the pupil and teacher on a common ground but viewing the situation from different points of view; the pupil supplying the bits of information that he has already picked up, and the teacher adding information that will direct the pupil into channels that furnish a more definite and clarifying understanding of the question in hand.

Of course some assignments must be made. I have found the boys ready and willing to try out the methods of producing fire, while the girls will take the easier task of producing the fire brands and clay models of the Greek and Roman lamps. And also as a matter of aid we have the modeling clay on hand ready for distribution. And right here let it be said that the teacher is to be more than reasonable in his demands for this kind of home study and home work. Never attempt or demand the impossible by asking the pupil to work with materials or instruments which he has not readily at hand. For example should the teacher ask the pupil to make a study of temperatures in the various parts of the home refrigerator, this task is at once impossible for those pupils who have no thermometers. Have your thermometers ready packed in strong cases ready to loan for such home work. The pupil borrows valuable books from the library for home work. Why not some of the hallowed things of the laboratory? Do you not think that he will take a pride in explaining and setting forth his knowledge of the thing in hand to his father, his mother, or immediate relatives and friends? Do you not think that his bit of private intimacy with the thermometer, electric bell, or whatever it may be, will not result in the best kind of self improvement and soundness of understanding?

Now what are we to do the next day when the pupils present themselves with fire brands, fire making apparatus, and Greek and Roman lamps? The first matter of importance is that each pupil be given an opportunity to exhibit before the

class the apparatus or materials with which he has worked, giving in his own manner the reason for selecting the materials and explaining the method of successful operation. If the pupil has failed to get the results for which he has worked, he is to explain the cause of failure from his point of view. This attitude of mind that discovers the reasons for failure is of the greatest importance and is one of the elements of mind training and character building that is to be emphasized throughout the course. After each pupil has reported his efforts, comes the class demonstration. The successful fire makers are to come before the class and operate their various implements in a contest for the production of fire. The remainder of the class are being acquainted with the various primitive methods and the relative merits of each. Of course these primitive tools are in inexperienced hands, and the performance of the operation may not be that of the expert, but the performing individual and the observing individual are receiving better concepts than teacher or book can ever impart. Next the fire brands and the Greek and Roman lamps are put into operation by the pupils who brought them, and various points of comparison and contrast are pointed out and emphasized. After the pupils have made their recitations and demonstrations, it becomes the teacher's part to develop those parts of the lesson which thus far have not been given full and proper expression by the pupil. In this lesson it is quite certain that the pupil will tell you that he rubbed the sticks together to produce fire or heat, it is the teacher's function to develop terms, definitions, and generalizations closely allied with this very act, such as *friction, friction results in heat, kindling temperature;* the girl who brought in the Roman lamp will surely tell you that the wick is for the purpose of conducting or leading the oil up to the flame; it is now the teacher's mission to develop the term *capillary attraction.* And so it goes throughout the entire course of projects, the pupil gathering together the concrete expressions, seeking for causes and effects in so far as he is able, and then the teacher stepping in as an assistant to help with the defining, abstracting and generalizing of the question under consideration.

As man progressed in his civilization his habits became more and more complicated, and since the projects enumerated above

are taken somewhat in the order of their historical development, we shall find that the presentation of the project becomes degree by degree more and more complicated. It is the business of the general science teacher to design and arrange his projects in such a manner as to direct the pupil through this labyrinth of human problems. Now it would not do to develop all the projects in exactly the same style and manner as we did those for the production of fire, fire brands and Greek and Roman lamps. The plan of attack and the program suggesting the order of action must be varied with each type of project. These changes and variation of method in the handling of the project plan are imperative, if the teacher desires to develop a pupil who at the conclusion of the course shall be prepared and equipped with a mental attitude of doing things and reasoning out the solution of problems for himself.

Consequently, when we take up the candle as our next project in the lighting of the home, we vary our method of attack and assignment for the home work. Here Michael Faraday in his *Chemical History of a Candle* has fully developed for us the best possible method of presentation, and the teacher can do no better than to follow step by step the methods therein suggested and assign as library or home reading definite portions of this wonderful classic. Instruct the class to make at home a dip candle as suggested by Faraday using paraffin in the place of tallow. Tell them to experiment with the candle in the same manner as Faraday did and to observe all the phenomena that he calls to their attention. (Here it is necessary to give to each pupil an ounce of paraffin, a short piece of glass tubing with fire polished ends, and a piece of fresh lime with directions for making and using lime water.) You teachers who have never read Michael Faraday's *Chemical History of the Candle* are not in position to grasp the importance of this kind of assignment. Michael Faraday lived in the days of candle lighting, in the days when the candle was household necessity and therefore was able to write from a standpoint of actuality that fairly radiates, and the teacher of sciences who fails or neglects to call these spirits of the past to aid him in presenting his subject fails in the development of refined tastes, of powers of appreciation, and mental growth.

The pupils are again before us after spending an afternoon

or evening with Michael Faraday and his candle. Again as before each pupil is called upon to relate his particular experiences, observations and conclusions. As the conference hour proceeds each succeeding pupil should be urged to present the matter with greater care of order and detail. The teacher who appreciates the value of scientific exposition, though expressed in a narrative manner by the pupil, will find that the majority of his pupils have acquired through their own effort a conscious order of things and facts. This is the kind of training desired, habits of mental activity that are orderly,—orderly without too much effort that labors for order. True some of his pupils will show a chaotic condition of mental processes while rendering the recital of the observations and interpretations of their personal experiences, and so here again it is the mission of the science teacher, like a Faraday, to point the way with patient indulgence. Then it is the teacher's business to give suggestion or question. The question or suggestion must drive straight to the heart of the subject under consideration. For the above project we may suggest or question as follows:

Did Michael Faraday talk about capillary attraction?

Did Michael Faraday give illustrations of capillary attraction?

Did Michael Faraday say that a candle flame needed fresh air?

How did Michael Faraday prove that a candle needed constantly a supply of fresh air?

What part of the air did Michael Faraday say was taken by the burning candle?

This kind of question calls for the answers set forth by Faraday, and so the pupil will set up reflective processes endeavoring to remember what Faraday actually said. A better way of presenting the suggestive question is to direct it towards the pupils personal experiences gained while working out the project. Such questions are as follows:

Did you discover capillary attraction at work in the burning candle? or better,

Why is a wick necessary in a candle?

Will any kind of a thread or string serve as a wick?

How did you prove for yourself that a burning candle needs fresh air?

What part of the air is necessary to a burning candle?

What new gases or products are delivered to the air in the place of oxygen?

Are man and animal dependent upon the air as is the candle?

On the other hand the teacher may not find it at all necessary to ask any questions; it may be the reverse, the pupil asking, the teacher answering. The best condition that can prevail is when teacher and pupils "gather together in the class room for class conference" for the purpose of comparing their individual experiences and formulating a conclusion or solution for the problem in hand. No home work should ever be attempted that can not be followed in class conference or in conference with the teacher, for the average pupils efforts on home work are in direct proportion to the amount of attention given to it.

Time and space limits prevent the outlining of other projects and the pointing out of the sub-projects in each case for home work. However let it be stated at this time that the child who goes into his home with proper oral directions or with easy written instructions of procedure for the study of the actual thing as it actually operates in his home, in his neighbor's home or in the community will have a better understanding of the construction and working relationship of the parts, than the pupil who is merely class taught from drawings whether they be on blackboards or in texts. The drawings that he makes of the system that he finds actually operating will be symbols of living concreteness compared with those of the student who endeavors to get his from diagrams alone. When each pupil has worked out a system for himself, then the drawings and designs of similar systems may be called to his attention and compared with those that he has made. In this manner heretofore meaningless diagrams and arrangements of things into systems express ideas and thoughts to him in much the same way that words, sentences and paragraphs of his story book express to his mind mental pictures of scenes and scenery. No problem in the text book or from the teacher will have the same effect as that which the pupil makes for himself while reading gas or electric meters in the attempt to calculate the family expense in this respect for a day or a week. When this is done, the problem of the text book offers itself as a wholesome challenge.

Throughout the course there is the desire on the part of most of the pupils to make or repair something in the home. In the University-School we give the general science course to the pupils of the eighth grade, and after they have worked through a few of the projects, they are continually seeking individual conferences concerning some piece of apparatus that has been suggested to them. One wants to make or repair a thermostat; another wants to rebuild or rewind a toy motor or dynamo or wireless set; still another desires complete details and advice on materials and details for the construction of a fireless cooker; another wants to know how to arrange lamps, wires, and switches that will turn on the lights at the house and off at the garage; and so it goes throughout the course. We seize on these opportunities and make capital of them, for we make that problem that pupil's project, and when the right time in the course presents itself, we invite that pupil to present his problem and his solution of it to his fellow pupils, not merely to discuss and tell about the project but to demonstrate it.

Another agent that aids the teacher of general science to carry the problems of the course in to the home is the portable projecting lantern, the lantern slide picture and the post card projector. The writer makes use of what he calls "the pupil's lecture." The teacher or pupil selects a group of slides or post cards bearing upon some future topic that will come up in the course. The pupil takes the slides or cards along with the lantern to his home. That night that family will have an illustrated lecture with the pupil acting as the lecturer. The help that he receives from the parent or friend to see deeper into the picture's meaning, or the criticism that he receives, depends, of course, upon the degree of family interest, and the ability of the members of the family to aid and criticise. Whatever the family attitude or ability be, the pupil has benefited from his recital and interpretation of the pictures to the family circle. The pupil may or may not be given a written description concerning the pictures that are loaned to him. It depends largely upon the subject matter. If the series of slides are on coal mining and the pupil is unacquainted with the machinery and terms of this industry, a written description must, from the nature of the case, accompany the slides. However if the group of slides are on the handling and care of

dairy products, it is better that he should carry his slides to the creamery and milk stations, and there find the machinery and tools and men in operation, and while there discover the worth and meaning of each picture and thus prepare his "pupil-lecture." The "pupil-lecture" thus prepared is given in the class conference when the related project is under consideration. When properly stimulated and directed it is difficult to over rate the value and immediate effect of this kind of work on the part of the pupils.

Again in every class individuals will be found who possess cameras and who are doing their developing and printing. These individuals can be taught in one short lesson the details of lantern slide printing and binding. When this is done the teacher of general science has a resource upon which he may draw whenever occasion may arise. For example long before we take up the project of "building our homes" one or more pupils are asked to locate homes in the process of construction and instructed to make a set of pictures starting with the excavation for the basement and ending with the completed home. Interiors as well as exteriors are taken, and a full set of notes kept of observations made at the taking of each picture. These notes record the different classes of working men and the different kinds of labor that each are performing at the several stages in the development of the house; the various materials and their uses; the installation of the many systems; gas, electric, water, sewage, heating, ventilating and vacuum cleaning; and any other items that the pupil considers of interest in the development of his problem. In this sort of self activity the pupil must do his own discriminating, his own comparing and contrasting; he must weigh and evaluate for himself; he must assign values. This sort of activity on the part of the individual develops a tendency to reflect, to reason, to investigate.

Since this paper has placed emphasis on the possibilities of home work, the writer would not have you think that all the work of the course in general science is to be done at home; that all the projects are home projects. By the very nature of the case some problems are confined in their demonstration at least to the laboratory and class room. Furthermore the writer would not have you think that his methods of assigning a

home problem for home study are the only methods of attack; he offers them to you as the best methods from his own experience. The writer's plea is that there be less empirical presentations, less abstraction and generalization concerning things and facts outside of the pupils observation and experience; a plea for the most effective methods of science teaching since the days of Huxley, namely a method of teaching by projects. Once we have established such conditions, the attempts of teachers of general science to translate to pupils of tender age the principles of life as exemplified in the home and community will have become a possibility.

Science Clubs That Work.

FRANK W. MURPHY, Irwin Ave., Junior High School,
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One day each week our 9th grade classes in General Science are conducted as Science Clubs. As soon as the class comes in on this day, it becomes, let us say, The Edisonian Science Club, and it is immediately turned over to the president of that club, who takes charge and directs the activities of the club.

This is a sample program: (1) Reading of the minutes by the Secretary-Treasurer; (2) Business to be brought before the club; (3) Collection of dues; (4) Report of the newspaper man; (5) A talk on milk; (6) Questions from the club about the talk; (7) The critics report; (8) Report of the judges; (9) Adjournment.

Parts (1) (2) (3) & (4) take very little time probably not more than 10 minutes. The president appoints a newspaper man, whose business it is to read the daily papers and call to our attention any news items of scientific interest.

As to the matter of dues, of course this is entirely voluntary, the pupils voting to assess themselves 1 or 2 cents per week. There are a great many interesting things that can be done with a small sum of money. One club left a picture of Louis Pasteur as a memorial for the club when it was graduated into the Senior High School. Another gave a picture of Edison,

another Franklin, another a splendid reproduction of the Alchemist by Teniers. The Edisonians have presented and are caring for a balanced aquarium; while the energetic members of the S. O. S. Club presented the school with a second hand Ford motor to be used in connection with our study of the gas engine!

The main talk (5) takes the greater part of the time of the period (perhaps 30 minutes). Two weeks before this time it is announced to the class that Albert Durbin is going to talk to the club on "Milk" and he wants to know what the class wishes to know about milk. It usually takes two or three pupils to help Albert take down questions that are hurled at him (unless he has had shorthand). These are some of the questions Albert received:

(1) How many bacteria are allowed in good milk?
(2) What is meant by Pasteurized milk?
(3) How much cream does the man take off before he sells it to us?
(4) How much does it cost in other cities?
(5) Which is better yellow milk or white milk?
(6) Where does all our milk come from? (distance from Pittsburgh)
(7) How do they keep it cool?

Albert gets busy and for two weeks he gathers material from every source about milk; he looks up anything he can find on milk in the library, he visits a dairy company, he reads any magazines he can get on the subject, he talks to the milkman.

When the president calls on him for his lecture he stands before the class, full of his subject, he is the complete master of the situation, he performs experiments, shows slides, or does anything that is necessary to present his subject. When you try it you will be surprised how well these pupils prepare for and present their subjects.

After he is through talking, Albert asks if there are any questions, he gives permission to speak, and answers questions about his subject.

If I were to give a complete list of all the subjects which have been presented, it would take too much space: but the following will suffice to illustrate the kind of material presented: Aeroplanes; Submarines; War Tanks; Lives of Edison,

Morse, Galileo, Watt, Pasteur, Faraday: Paper Making; Jelly Making; Is Mars Inhabited? The Telegraph; The Telephone; How Glass is Made; How Iron is Made; Helium Gas; The Storage Battery; Radium; The Steam Engine; Linen; Divers; Coal; Dyes.

I leave the pupil free to select his own subject, merely saying that "It must be science but that the field is broad." It is the duty of the Club's officers, namely, the president, the vice president and the secretary-treasurer, to make out the programs. These are made out by the officers as soon as they are elected for their entire term of office-six weeks. Of course the teacher is always ready to give his advice on anything. The programs are brought to the teacher for his "O. K." before they are posted. The only rule we make is that every one in the class must be put on for a main talk sometime during the semester.

I cannot overemphasize how fine some of these talks are. I frequently have talks on a subject given in a far better way than I could do myself. I remember one boy's talk on aeroplanes where the boy had gone to an aviator and talked with him on his subject so that the information he gave was not only valuable, but extremely interesting because of its being first hand. Another boy made a flying model for his talk on aeroplanes and at the close of his lecture took the class outside and flew his plane for them!

The critic's report (7) comes near the close of the meeting. This pupil has been appointed "Critic" for the day by the president at the beginning of the meeting. He comments on the good and bad features of the meeting.

I have found the work of Morris Meister as published in the May 1918 and May 1919 numbers of the QUARTERLY, to be very helpful. We have the list of suggestions for the speakers which Mr. Meister gives mimeographed and given to each speaker. The list of books which he gives on page 211 of May 1919 QUARTERLY are invaluable for this work. It is the most "workable" list we have ever seen. We need more books of this type to place in the hands of pupils of Junior High School age. The Board has very kindly purchased these books for the working library which we keep in our science room.

We find however with the pressure of five or six classes of forty or more pupils each day upon us, that once per week is as often as we can have club work and get it properly supervised. Of course it would be ideal to have it every day. I can recommend the Club Day once a week though as a very practical thing for the busy science teacher (in the QUARTERLY at least, we can admit that we have more work than teachers of other subjects) if for no other reason than the relaxation that comes to the teacher in sitting in the rear seat and getting the *point* of *view* from *that position.*

A few merely "mechanical" ideas like these prove valuable: We have some pupil in the Club, who takes Art, make a card bearing the name of the Club (such as shown in Fig. 1) these cards are put up in the room. At the end of the week we place a small American flag (see Fig. 1) on the card of the club which had the best program for that week. We keep track of the number of times a Club has won first place, as shown in the illustration by having the emblem of the club put down as a star in the Standing of the Clubs.

A section of the blackboard is given over to this. Each club chooses a scientific emblem such as a retort, bell jar, etc. At the end of the year the club which has the most stars (emblems) is given an entertainment at the expense of the other clubs. The spirit of competition is keen at this age and any appeal to it is sure to succeed.

As I stated before, these are merely devices to keep the idea of the club before the class. For the same reason we allow a short musical number (such as a violin solo) a place on any program.

The teacher must give a great deal of attention to making the first few programs a success; for the pupils have not been used to this sort of thing, afterward they gather momentum, and will not need such close supervision. The officers hold their office for six weeks, and then new officers are elected by the class.

We are now in the second year of this club work at Irwin Ave. Junior High and this year Mr. Hole at Latimer has tried it with very great success.

We believe we learn to do things by doing them, the pupils are going to be voters in a democracy, how better can they learn to vote than by voting for the best officers for their club! Some of the boys are going to be presidents of their city and

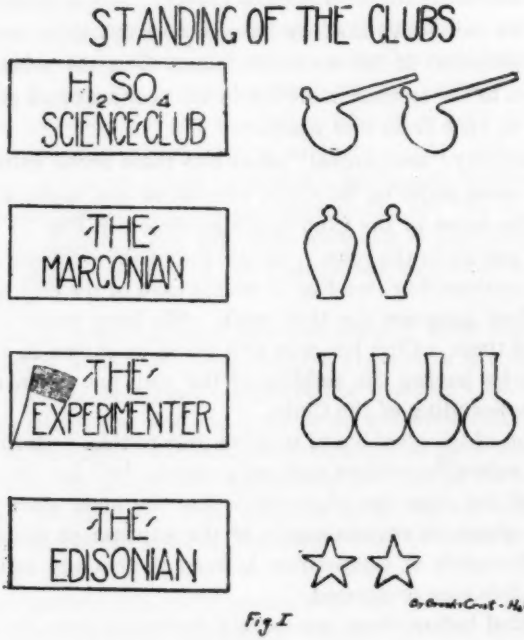

Fig I

borough councils, how can they learn to preside over a meeting than by presiding. How can they learn to make a program except by making one! Many of them "find themselves" in getting before the class either as president, or as secy-treas. or as a speaker. We believe, in the words of Dr. Kilpatrick, that Science Clubs have a broader influence than merely teaching science and that such work "leads on and on and on."

We do not believe in the "Law of the Medes and Persians which changeth not," so we are constantly experimenting, and have no constitution and laws, save only to make the Science Club day better—to make it lead on!

Democracy — Its Common Heritage and Its Common Obligations as Taught by General Science

BERTHA MAY CLARK, William Penn High School, Philadelphia.

Dallas Lore Sharp in "Patrons of Democracy"[1] asks an old, old question, one that has been uppermost in the minds of educators for years, "What is the true end of American education, life or making a living?" And answers very forcefully and startling it seems at first, "That it is neither life or making a living, because all can live and get a living without education," the very beasts of the field do as much. He feels and I am sure that we must all agree, that the main end of education in this country should be the knowledge of democracy and the practice of democracy; the knowledge that all must live and get a living but that all must do it *together* as part of a *common* experience, a *common* heritage and most of all as part of a *common purpose;* the practice by all at all times, but especially during the formative days of school life, of liberty, of equality and fraternity. General science, because of its breadth of content, and its manner of treating individual, community and social problems, is a beacon light to point out to students how the passion for equality, the ideal of humanism, the belief in fraternity are hampered and stifled when environment controls man but are fostered and furthered when man controls environment.

When rivers swollen by heavy rains sweep away houses, destroy crops, spread hunger, pestilence and death over the devastated land, environment controls man; when man, armed with tools and machines, builds levees, dikes, breakwaters, and reservoirs to hold back the angry, surplus waters, he controls environment. When in the heat of summer valuable food rots, environment controls man, but when in refrigerator and cold storage food is kept fresh for days and months, man triumphs over environmental hindrances. When in primitive times, man wandered from place to place in search of wild grains and berries, living now here and now there, environment was the

[1] Atlantic Monthly Nov. 1919.

master and he the follower; now when man by agriculture grows on a few acres crops that unaided Nature could not produce on thousands of acres, and no longer roams here and there in search of scanty food he has the ascendency over environment.

In order to see how general science or acquaintanceship with environment, sympathetic understanding of it, and wise mastery over it, leads toward a knowledge and practice of democracy we must know, what makes possible certain actions of man that humanize him, that distinguish him from other animals, that urge him to do many things over and above getting a living and keeping his body in good working condition.

Need is the first experience of life, need of food perhaps or need of shelter or air; efforts to satisfy the first needs and others like them, give rise to definite habits and to fixed ways or customs. "These habits and customs are formed unconsciously and are not creations of human purpose; they are like the instinctive ways of other organisms, growing out of the experience of need, and the manner of satisfying the need and are no better or worse than similar ways in animals."[2] But when into man's instinctive ways of satisfying needs, of meeting the struggle for existence, there creeps the idea of what is good and right for the community then these mere animal ways are raised to an ethical plane and exert an elevating influence upon society. Ways of instinct and self preservation then become ways of reason, of purpose, of race development. As environment changes, the problems of existence change, ways of satisfying needs change, and in consequence social customs change. Anything which increases food supply, alters the struggle for existence and makes men crowd less and less upon each other. The introduction into Ireland of white potato in the 16th Century (1586) raised many a peasant's home above starvation level; the introduction into the northern United States and Canada of hardy types of wheat capable of withstanding a rigorous climate opened new fields to man's activities; lessened man's competition for food and gave opportunity for higher development of societal standards and customs.

Meyer's work as a plant hunter in China is a fine illustration of man's power to increase food supply. On the far plains of China he found growing a hardy peach capable of withstanding

[2] Sumner-Folkways.

drought and alkaline soil. He sent 1500 lbs. of pits to America and there are peach orchards in California today whose underground parts are Chinese roots developed from these seeds.[3] Profound changes in land physiography such as were brought about by the building of Panama Canal, the erection of irrigation plants in arid regions, the construction of aqueducts from Catskill Mts. to New York City initiate profound modifications, whether recognized or not, in the competition of life, and consequently in societal standards.

As men because of increased production, and decreased consumption crowd less and less upon each other for food, shelter, clothing and other necessities os as they more perfectly understand and use their environment, they can better and better afford to adopt ideas and institutions consistent with freedom and equality for all, and they usually become more and more willing to do so. The rapid growth of democracy, is due largely to man's increased power nature, that is, to his ability to make many plants grow where formerly only one grew, to his ability to produce breeds of animals especially adapted to human needs, to his power to harness the energy latent in water, oil and coal, to his skill in overcoming the ravages of plant and animal pests.

Mastery of environment as often means cooperation with environment as dominance over it, and there is not the slightest doubt that cooperative lessons learned from nature by the few tend to be put in practice for the good of all. How often among lower forms of life is seen a combination existing when each of its members would either perish without the other or at least would fare less well. The beech tree dies when its roots are deprived of the organism which grows upon them but in return transmit soil food to them. Tolerance by the farmer of cherry eating robins because of the harmful insects eaten by robins at other times is a commonplace illustration of cooperation between man and animals.

The effect of crude materials, of natural forces, of peoples, in other words, the effect of environment upon man, and the counter effect of man upon environment are so closely related to democracy that if we grant that the aim of education is the knowledge and practice of democracy then we must lay special emphasis upon those subjects which deal primarily with the study of environment.

[3] National Geographic Magazine 1919.

General science may start with the most immediate environment of the pupil, namely himself, or his next most immediate, his home, or it may begin with community projects, such as water supply, markets, sewage, quarantine. No matter where the subject is begun, the emphasis will be put upon man's relationship with other organisms, like or unlike himself; if for example, the particular lesson is on the need of good conditions in the home, and on the dangers of overcrowding or on the welfare of children in general, then the procedure can be briefly somewhat as follows;

I. Provisions seen in plants and animals for the welfare of their offspring.

(a) In animals.

Butterflies flitting from plant to plant and finally laying eggs on plant that the young caterpillars will eat.

Bees sheltering their young in hives; different kinds of food fed the young, and the development of the young into workers, drones, queen.

Birds sheltering their young in nests. Study all types of nest from loosely made ones on the ground to the beautifully constructed ones of the Baltimore oriole on a high branch.

Birds feeding young; teaching them to fly, in some cases to swim.

Kittens and pups in safe place by parents; fed with milk from mother.

Cats carrying kittens to safe place after they have been disturbed.

Fish—and their haphazard way of laying numerous eggs, with slim chances of fertilization and development into offspring.

Lack of parental care of offspring.

Contrast methods of fish with those of bees, birds and mammals, showing the advantage to offspring of the latter methods.

Length of period of infancy correlates with number of young. Grouse, on the ground, exposed to danger lay 20-30 eggs, eagles high in the air lay 2-3 eggs; grouse hatched from eggs walk and secure food immediately. No chick-

hood. Young eagles are cared for during several months. Apply to human family; fewer and better children needed; less mortality from disease an aim!

(b) In plants.

Bursting of pod of sweet pea scatters seeds of sweet peas and insures better conditions of air, light moisture for the germinating seed and young seedling.

Bitter kernel of peach protects embryo on which a future generation depends. Attractive color and taste of cherries aid in scattering cherries and thus lessen overcrowding of plants.

Food stored in seeds provides the germinating seed and young seedling with food until it is able to shift for itself.

II. Provisions that should be taken by parents and society for the welfare of children.

(a) Elimination of overcrowding by good housing conditions. Privacy for each family and each individual in family. Cheerful family atmosphere.

(b) Adequate sanitation; good water, ventilation, safe sewage disposal.

(c) Sufficient sleep, regular meals, exercise, bathing. Pictures to show day well spent from the point of view of health, acted by some interesting person, such as movie star or base ball player.

(d) *Education* for livelihood.

Emphasize the need to select an occupation adapted to the individual or that pleasure may come from work.

Long period of education of young makes serious drains on parent and society. Moral obligations of each pupil to make adequate returns to society for benefits thus bestowed upon her.

Education—for leisure, for recreation, for life.

Reading. Attractive pictures of free library reading rooms; joy of books of adventure, out of door life.

Athletics—as recreation in cities; insist upon many interests that center in a well equipped play ground.

Interest in sports lead to healthy companionships between boys and girls. Show pictures of exhibitions and competitions in diving and swimming; match games in tennis; boy scout camping parties.

The emphasis of general science should be put upon ways by which *desirable changes in nature can be brought about,* ways by which environment can be made to yield more material and hence more freedom to all. The average farmer plows, harrows, plants and cultivates about one third of his corn acreage without returns (Bailey-Cyclopedia Agriculture). Time, strength, crops wasted. Why not emphasize the need of three-thirds efficiency? Fourteen ears of corn are needed to seed one acre. If but one row of seed corn be poorly selected, ¼ of the crop is wasted. How important then to emphasize seed selection. If improvement of crops by selection be presented, why not improvement of the race by selection? "It is within the power of man to cause all preventive diseases to disappear from the earth."[1]

Again the emphasis should be placed upon ways in which *undesirable changes can be prevented*; such as encroachment upon land of the ocean as along the Jersey coast. Fire prevention, loss by fire of forest trees, homes, food supplies, etc. "The chief terror of the sea in the past has been collision in fog; for decades and for centuries we have needlessly allowed ships to go down year by year simply because we have not realized the possibilities of prevention through organized research. Out of the anti-submarine efforts of scientists has grown a device by which it is possible to eliminate the dangers of fogs. The preventing of a single disaster like the sinking of the Titanic or of the Empress of Ireland more than pays, without any reference to the value of human lives, for all the time and money spent by England, France and United States combined in developing detecting devices."[2] No attempt should be made in general science or any high school science to train pupils for technical work; far greater good will have been achieved if the pupils get a conception of the worth of human life and the value of scientific research, and the vital need of public support of research laboratories.

But an understanding of soil fertility and rotation of crops, for example, is not worth while unless bound up with it, is the conscious and subconscious purpose of increased production, for the sake of fellow workers. To know(for another example, how to prepare tasty nourishing food, to select warm clothing,

[1] Pasteur.
[2] Millikan-Science, Sept. 26, 1919.

to provide comfortable shelter, to maintain healthy bodies should be but a secondary result of general science teaching; the main result should be a glimmering, however faint and fleeting, that these things are milestones in man's conquest of environment, in man's emancipation from material fetters, and hence milestones in man's willingness and eagerness to recognize and to work for liberty, equality and fraternity for all.

The first task to which general science sets itself is to acquaint a pupil with his environment, immediate or remote, so that he recognizes its wide and varied influence upon himself, his possible constructive purposeful reaction upon it. Each of us is affected by every move made by every one else. If this were not true our boys would not be lying dead "on Flanders Field." Other tasks of general science to make part and parcel of the pupil the knowledge that human needs and desires in an ever increasing world can be satisfied only by scientific use of materials, and by filching new secrets from nature; to keep continually before him the fact that folkways and the customs of peoples are generally elevated by lessening of the competition of life, that is, by increased power over environment and closer cooperation with environmental factors; to make part of his subconsciousness the idea that real democracy can be attained and retained only when all produce as much as possible for all, when all consume as little as is necessary from the common store of the world granary and when all are guided in personal and public affairs by thoughts of race development, and not personal gratifications. Contrast such actions and ideals with those of strikers!

If such a task be accomplished by general science, the result will be unselfish action by its pupils and the world's prospective citizens.

Unfortunately unselfish action alone does not guarantee race betterment. The mother, who through supposed unselfish action, pampers her child, does not improve the race, nor do social reformers, who are ignorant of scientific principles always further race progress. Untrammeled thinking, as well as unselfish action is essential. The second task of general science is to teach by experiments in the laboratory how to prove all things in order to know what is good and what to hold fast to. Anything no matter how simple, that can be called an experi-

ment offers opportunity for keen observation, untrammeled deductions constructive conclusions, and develops the scientific spirit of "prove all things." General science because of the variety of matter presented offers experiments on widely different subjects and of widely different procedure and teaches a pupil how to test what is true in many different phases of living. By its avowed allegiance to the simple, the commonplace, the practical, general science teaches the scientific spirit in a manner understandable to immature minds and at the same time sacrifices nothing to its fundamental tenet of the study of environment, of relationship, and interrelationships.

When general science was first taught in the William Penn High School it centered around the home, the individual. The food eaten, the clothes worn, the water drunk, were the important facts, the important thoughts. Unsigned slips turned in the end of the course in response to teacher's requests for the value of general science contained such statements as;

I am familiar with things in my home; I am more alert at home, I run the stove now without smoking and the furnace without coal gas. I read pure food labels on packages and cannot be cheated. I am interested in commonplace happenings. I try to lead a healthier life in order to work better.

Now that the interest of general science has shifted from man as an individual in a home, or in a school, to man as a member of a democracy, the answers are very different to the question, "What has general science done for you?"

1. It has taught me that *things don't just happen; we can control them.*
2. I *don't do anything without it is passed on,* and keeps or hinders those who come after me.
3. I can change environment and make it better.
4. I must be healthy, so as not to pass on disease to the race.

General science has one fundamental aim, to further democracy,—it does this by teaching the common scientific heritage of each and all, and the common scientific obligation of each and all; by teaching that man is the scientific heir of all the age, of all those who have gone before him; and that he is the scientific ancestor to the future ages, to all who come after him. Progress in democracy depends upon how we use our scientific inheritance and fulfill our scientific obligation.

The Project As a Teaching Method.

R. W. SHARPE, DeWitt Clinton High School, New York City.

The criticism that the subject matter taught in schools is quite largely isolated from the experiences of pupils outside the schools, has led to the formulation of the project method of teaching.

The method of the project had been variously interpreted with various results—mainly unsatisfactory. Most failures result from lack of recognition:

1. That projects must precede principles.
2. That principles are better understood when developed as the learner needs them.
3. That projects must be organized so far as possible, in their natural setting.

Faulty organization of material and projects has no doubt caused most of the poor results in science and other teaching. Wide spread study of the causes of faulty organization has resulted in a formulation of the term project, that if consistently carried out, will doubtless eliminate much of the unsatisfactory results toward which honest and well considered criticism is now directed.

The term project has probably been most satisfactorily defined as, "A problematic act carried to completion in its natural setting."[1] This evidently means that there must be:

1. No passive reception of information by the pupils.
2. Reasoning rather than memorization.
3. Priority of the problem over the learning of principles.
4. A setting for the problem in the schools as near as possible to that found in life outside the schools.
5. A plan of action looking into the future, which when carried out, results in a thing accomplished.

A splendid characterization of the term project has been given by Dr. C. R. Mann as:

1. A desire to understand the meaning of some fact, phenomenon, or experience. This leads to questions and problems.
2. A conviction that it is worth while and possible to obtain an understanding of the thing in question. This causes one to work with an impelling interest.
3. The gathering from books, experiences and experiments, of the needed information to answer the question in hand."

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[1] Stevenson.

This means that the student works in much the following order:

1. A state of perplexity or of curiosity.
2. Work is begun with enthusiasm because this perplexity or curiosity is the result for a solution.
3. Once the difficulty is clearly defined the pupils enthusiasm carries him to a solution which is almost automatic, but which in reality is:
   a. A process of supposition, guess, theory or hypothesis, pending further evidence.
   b. Reasoning out the evidence as discovered.
   c. Deliberate weeding out of the false so as to arrive at a conclusion.
   d. Application of the conclusion to other similar situations.

Quite likely most teaching is done by topics rather than by projects. "Projects are superior to topics, in that the project originates in some question, and not in a logical arrangement of matter as found in most texts. While teaching from topics in text books, the teacher wrongly attempts to induce pupils to accept topics as their own projects. Topics mean a formal didactic treatment in which the teacher does all the thinking and the pupil absorbs and memorizes. Projects in their life setting lend themselves to a selection of facts according to their value or significance to the pupil. Topics furnish no such basis for selection."[2]

Again, many teachers who recognize the value of the project method, fail to carry the method of the project to a satisfactory conclusion. This results from the attempt to cover too much ground, and the teacher attempts to hurry the pupils, forgetting that what may be very simple and obvious for the teacher, may be very obscure for the pupil. The teacher, therefore, interrupts with his own thinking, and prescribes the procedure to be followed by the pupils to such an extent as to kill the students initiative. Too much text book work brings about the same result, while a good reference book in the hands of the pupil, to be used as he feels the need for it, is quite another matter.

With the foregoing status of the term project in mind, as used in science teaching, the writer presents below some observations made of the methods used by a few writers of texts and so-called syllabi in science, with a view to discovering to what extent these writers are succeeding in teaching or or-

[2]Woodhull. General Science Quarterly, Vol. 2, p. 249, Nov. 1917.

ganizing by the project method, as defined by our best authorities.

Let us take the subject of transportation. One text contains the following organization of subject matter.

PROJECT XVII—TRANSPORTATION

1. Importance of transportation—Animal power compared with steam and electric power.
2. Water as a medium of transportation.—Why substances float or sink.
3. Archimedes principle.—Specific gravity.—Submarines and the floating of iron ships.
4. Steam engines—The first steam engine—The principle of the steam engine. Locomotives and steam ships.
5. Steam and gas engines compared. How a gas engine works—The automobile.
6. Electric power—The parts and working of an electric motor—Electric cars and locomotives.
7. The dynamo compared with an electric motor—The principle of the dynamo.
8. Power stations.
9. Kinds of water wheels.
10. Water power and the protection of forests.

Here transportation is evidently not a project, although so named, but is really a chapter heading. An introduction is given as preparatory material properly enough, followed by some "problems" or experiments, as follows:

1. Why do some objects float in water?
2. What is the specific gravity of iron?
3. What is the principle of the steam engine?
4. What is the principle of the gas engine?
5. How does a steam engine work?
6. Study of an electric motor.
7. Study of a dynamo.
8. Visit to an electric light station.

This is followed by a number of topics amplyfying the principles which motivate the giving of the didactic problems and exercises given above. This in turn is followed by a number of "individual projects."

This violates the characterization of a project in that, there are few real problems at issue that are similar to those arising in real life. There is little or no natural setting. The pupils are led arbitrarily and didactically to consider (a) Why objects float. (b) The specific gravity of iron. (c) The principle of the gas engine. (d) The principle of the electric motor and dynamo. There is no staging of the real problems. Certainly pupils would not naturally follow this order in at-

tempting to solve the problems of transportation, let alone calling the general chapter heading a project. Here principles come first, followed by applications,—a discarded method.

The use of a natural method of organization would much more likely result in staging the material somewhat as follows:

1. What makes boats float and submarines sink?
2. How may we transport a comparatively heavy load with a a small force?
3. How may steam be used to pull heavy loads?
4. How may water wheels be used as a source of power?
5. How does electricity run a street car?
6. What makes things go?

These are likely questions that arise in the minds of pupils. There is no thought of the scientific principles involved or of the atmosphere of the school room. Of course, pupils might bring up these questions in somewhat different wording or order, to be immediately seized upon by the teacher acting as stage manager or director. Principles are ultimately arrived at, if these projects are solved to a satisfactory conclusion. Generalizations and applications naturally follow.

Another recent text presents the same matter as follows:

CHAPTER VI. TRANSPORTATION ON LAND.

1. Vehicles—Primitive vehicles—transportation and topography.
2. Roads and vehicles—kinds of roads—roads and motive force.
3. Railroads—location of grades.
4. Curves, inertia and effect—effect of change of direction.
5. Bridges—principle of the girder—truss, tubular and suspension bridges.
6. Steam and the locomotive—operation of the steam engine—condensers.
7. Production and control of steam—boiling temperature and high pressure—amount of heat required—evaporation and condensation etc.
8. Electricity as a motive power—motors—generators and transformers.
9. Gasoline as a motive power—gas engines—dependence upupon other mechanisms.

The above topics are explained and made clear by means of ample exercises which are good in themselves, but again there is no attempt to organize the material around the questions naturally arising in the minds of the pupils. That the topics are likely intended to serve as suggested projects, is evidenced by the authors' statement in the preface, as follows: "The general method of the book in dealing with the topics, or projects, selected for study is broadly inductive or heuristic, etc.,"

although the term project is not mentioned elsewhere in the book, so far as the writer can discover.

Another recent "syllabus" attacks a portion of the topic transportation, confined mainly to the source of the necessary energy, under the chapter heading "Relation of air to everyday activities," as follows:—

RELATION OF AIR TO EVERYDAY ACTIVITIES.

A. Oxidation.
What makes an automobile go?
Oxidation of gasoline.
Examine diagram of an automobile engine.
Find parts corresponding to a simple cylinder—
a—Piston and cylinder.
b—Wires carrying electric current.
c—Place where spark is produced.
d—Tube carrying gasoline and air.
e—Carbureter.
How is the power developed by the explosion in the cylinder applied.
Toy crank shaft—diagrams of gears.
Action of a 4-cycle engine.
Diagram showing,
1—Suction stroke
2—Compression stroke.
3—Power stroke.
4 Exhaust stroke.
Why do autos have fly wheels?
Advantage of an engine having many cylinders.
How the spark is produced in an auto.
Need for a timing apparatus.
Need for arrangements for cooling engine—air and water cooled.
Need for an oiling system.

B. Burning or oxidation as a source of power.
Other substances used as fuel.
What happens in burning.
Burning a match—rusting of iron—other causes of slow oxidation.
Spontaneous combustion—explosions.
Why coal is burned.
Need for energy in human body—how supplied—need for a blood system.
Do plants breathe as animals?

C. Prevention of destructive oxidation.

D. Importance to us of the gases other than oxygen that compose the air.

The writer of this syllabus alludes to the term project only in the following sentence:—"Pupils should be encouraged to

work out certain *projects* or *topics* suggested by class work, each pupil to demonstrate the project to the class at a later period." Seemingly there is no attempt to distinguish between topics and projects. The term problem is frequently used, but there is little to suggest and it is not likely, that this term is used to signify a project.

The best definition of a project would exclude such a heterogeneous collection of topics as above given under the heading oxidation, but would be best met by organizing the material about a project in its natural setting, somewhat as follows:—

PROJECT—*What makes anything go?*

Introduction or Approach.

What problems arise for solution?
Evidently something is needed associated with heat-energy.
What needed? Evidently a fuel, and some means of control as a stove, engine etc.

Reasoning.

Need for a kindling temperature.—example of the match.
Given fuel and a kindling temperature, is air necessary?
What portion of the air is used? Burn phosphorus.
This portion called oxygen—rest mainly nitrogen.
Oxygen supports burning or combustion.
Combustion of wood or iron wire in oxygen.—example of rapid oxidation.
Rapid oxidation of gasoline in a coffee pot cylinder.
Fuel must be in a condition to burn very rapidly, and must be confined or controlled.

Conclusion.

Demonstration by pupils, showing how rapid oxidation of a controlled fuel "makes things go." That given the proper fuel, the proper kindling temperature and air (oxygen), there is still needed a means of using the resulting energy and a means of getting rid of the wastes.

This naturally leads to a discussion of the adaptability of various fuels for different purposes, and what happens when they are burned. Problems sure to be suggested and worked out in class or by individual pupils as independent problems, are:—

What happens when a candle burns? When we burn a match? How to make a match? Cause of smoke? Stoves, gas ranges, lamps etc.—rusting of iron—this called slow oxidation.
Spontaneous combustion and explosions, etc., and how prevent destructive oxidation.

Sooner or later will arise the question "What makes living things go?" This leads to a study of foods as fuel, means of

getting oxygen into living bodies, and how get rid of the wastes.

The pupil is thus led to solve in some such manner as above the general import of the project of "What makes things go?" or the source of power or energy, before he concerns himself with the machinery of autos, etc., necessary to handle this energy. Some pupils indeed, may wish to work out the mechanism of an auto, but in the main he should be discouraged at this particular point, as being much too difficult for the average pupil. Here it is the business of the teacher as director to see that pupils do not bite off more than they can chew, let alone digest.

The method just outlined permits of a natural setting, forces the attention upon the problems at issue, and facts and principles are learned almost unconsciously. The natural setting provides a strong motive. Finding out "What makes things go? is far more interesting than any study of oxidation introduced as such, or "The Composition of the Air" or "The Relation of Air to Every day Activities", or "What makes an Automobile go" if that means much attention to mechanical details.

While all projects may not be equally interesting to all pupils, yet interest in projects selected by pupils is likely to be very intense. All of this means that in place of a so-called syllabus, so commonly used as the basis of the course in science, projects form a much better basis. It is only necessary to decide what facts and principles should ultimately be mastered by the pupils, and then select groups of projects from which the pupils may make selections. These selected projects will be such that all the facts, processes and principles needed will be covered which are commonly given in the logical or systematic presentation of the subject. The project is used as the *approach* in all cases after which it is comparatively easy to systematically summarize the entire field, if desirable.

SUMMARY:

1. Projects must precede principles.
2. Principles are better understood when unconsciously worked out as the pupils need them.
3. Projects should be offered in their natural setting, so that the situations undertaken in school are not essentially different from what they would be if undertaken in the environment outside the school.
4. The applications of the principles learned in solving such

projects readily suggest themselves in solving other problematic situations.

5. Topics as given in ordinary syllabi, lend themselves to no such treatment.
6. Projects encourage the pupils to do their own thinking, while the teacher acts as guide and counselor, and provides the stage setting.
7. Even a mediocre text in the hands of the pupil, *to use when needed,* gives confidence to the weaker pupils, and assists them over many an obscure point.
8. Syllabi are as deadening to teachers as to pupils, and explains much of the poor teaching done in our science classes. Teachers are just as likely to be interested in projects as are the pupils.
9. Many suggestive projects should be outlined in a course of study, in place of a syllabus. These projects should be such as to include all the facts, principles and processes which are commonly covered in a logical or systematic presentation of the subject. The topic method is thus avoided—a method deadening alike to teachers and pupils.

Free Booklets

FIRE TRAGEDIES AND THEIR REMEDIES

This deals with school fires and will be of value in all science classes. It is only by a campaign of education that our school fire hazards can be removed. This illustrated booklet will give you splendid help. Send to *General Fire Extinguisher Company,* Providence, R. I.

Teaching Helps

TEACHING, the journal published by the *Kansas State Normal School,* Emporia, Kansas, has material of interest to science teachers, as follows:

No. 43, Oct. 1918 "Methods in Physics and Elementary Science."

No. 44, Dec. 1918 "Science: Biological and Physical."

No. 45, Feb. 1919 "Examples of the Project-Problem Instruction."

No. 47, Sept. 1919 "Lists of Science Books and Magazines for Senior and Junior High Schools."

Studies of the Masters

By JOHN F. WOODHULL

IV. FARADAY

This is the story of a man who did not go to school enough to be bored by it, but who nevertheless became "the greatest experimental philosopher that ever lived" and received scientific honors and degrees from almost every academy and university becomes great, but this one did. At thirteen a newsboy; at twenty-two a bottle washer in Davy's laboratory; at thirty-two, a world renowned "natural philosopher."

He was born in 1791, six years before Lyell and eighteen years before Darwin; and died in 1867, eight years before Lyell and fifteen years before Darwin. At the period of life when other boys attend high school and college he was the faithful apprentice to a bookseller and stationer. He found time to read many books and attended public lectures; notably those of Mr. Tatum on Natural Philosophy and those of Humphry Davy on Chemistry. How he made the transition from bookbinder to assistant to the most famous scientist of the time is told in his own words as follows: "My desire to escape from trade, which I thought vicious and selfish, and to enter the service of science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir Humphry Davy." He inclosed notes which he had taken of Davy's lectures and which he had transcribed with great pains. These, his chief introduction and recommendation, won him the position he coveted. Those notes are still on exhibition at the Royal Institution. At the age of twenty-two, therefore, the age when other young men emerge from college, he without any formal education entered Davy's laboratory. His nominal duties were those of laboratory attendant and his remuneration was $6.25 a week and room. But from being the right hand man of Davy he obtained a rare education and when Davy retired no one was so fit as Faraday to succeed him.

Faraday who had been born in London and who had never traveled more than twelve miles from home—never having

even seen the sea—was now destined to begin his real education by travel as Darwin did afterwards. He and Davy spent eighteen months traveling through France, Italy, Switzerland and Germany. On this trip he met numerous great men such as Ampere, Clement, Desormes, Gay-Lussac, Volta, De la Rive, etc. He studied iodine, heard Gay-Lussac lecture in L'Ecole Polytechnique, the national school of chemistry, to about two hundred students; studied the glowworm and torpedo (an electric fish). In Florence he helped Davy burn the diamond, proving that with oxygen it furnished nothing but carbon dioxide and hence is pure carbon. Neither Davy nor Faraday ever confined their attention to one science. They preferred to be natural philosophers. Faraday's notes of this trip are filled with chemistry, physics, geology, water sports, museums, churches, mountain scenery, habits and manners of the people, etc., etc. He notes his impression of the people as follows: "Politeness is the general character of the (French) people. A character which they well deserve; but the upper classes have carried it beyond the bounds of reason, and in politeness they lose truth and sincerity." "Their conversation is very vivid and uninterrupted, but though it dwells for hours on the same subject, you can scarcely make out what the subject is."

At Paris everything yields to appearance. Many starve in a garret to go well dressed.

In Italy he found "a degenerate, idle people—cramped by ignorance and buried in dirt. Begging is almost the birthright of modern Italy. All are beggars in some way. This detestable habit of universal begging is imbibed by the children even with the mother's milk."

Rome: Saturday, November 26, 1814 "I find myself in the midst of a crowd of people who delight in deceiving; are ignorant, faithless, frivolous. Their want of honor irritates me, their servility disgusts me, and their impertinence offends me."

Faraday played the flute, sang bass, was a church officer, read novels for recreation, married at thirty, defined love as "A nuisance to everybody but the parties concerned." "A private affair which everyone but those concerned wishes to make public," was a normal and most agreeable man, with ardent devotion for his wife, his church and his science.

Faraday's method like that of Lyell, Darwin and every other scientific worker, was the project method, the method of problem solving, which begins with the whole and arrives at the parts by analysis. It is the reverse of the method which obtains in school where science is presented as principles, and these parts are organized into a whole by synthesis. This method not only kills interest, but fails altogether to prepare pupils to learn from experience. Those who, like the masters have the germ of the scientific mind in youth are most bored by the unscientific methods of the schools.

No man ever felt the tyranny of definitions and symbols more deeply than Faraday did. He would propose a new terminology and displace all terms tainted by a foregone conclusion. He said "In our conceptions we make use of symbols which afford peaceful lodging to the intellect for a time, but they also circumscribe it, and by and by, when the mind has grown too large for its lodgement, it often finds difficulty in breaking down the walls of what has become its prison instead of its home."

In discussing the mode of propagation of light and radiant heat he endeavored "to dismiss the ether, but not the vibrations." He said "I cannot form any idea of atoms apart from the forces. They do not afford me the least help. On the contrary, they greatly embarrass me." He contended against the "action of forces at a distance" and the adoption of two electrical and two magnetic fluids.

The idea of "action at a distance" constantly perplexed Newton as well as Faraday. Newton said "That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum and without the medium of anything else by and through which this action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it."

Both Newton and Faraday required a physical basis for their speculations. The ether, "more solid than steel but weightless," which we teach boys and girls to prate about so complacently was inconceivable to these great minds. They might have said with Fournier "The physicist has almost developed into a mystic—endeavoring to reduce matter to some unintelli-

gible turbulence in an inconceivable ether."

Tyndall, who worked with Faraday as his disciple and who became his successor at the Royal Institution, says "He knew well that from every experiment issues a kind of radiation, luminous in different degrees to different minds, and he hardly trusted himself to reason upon an experiment that he had not seen" and Faraday himself said: "I was never able to make a fact my own without seeing it, and the descriptions of the best works altogether failed to convey to my mind such a knowledge of things as to allow myself to form a judgment upon them. I never could work as some professors do by students or pupils. All the work had to be my own."

Faraday usually worked according to a preconceived idea. He tried to magnetize a needle by a sun's ray. He tried the effect of a magnetic field upon a beam of light to ascertain whether there was any change produced in the refrangibility of the light. This was in 1862, thirty-five years before Zeeman discovered the effect; "A scientific prevision little short of miraculous." "A great deal of nonsense is I fear uttered in this land of England about induction and deduction. Some professing to befriend the one, some the other, while the real vocation of an investigator, like Faraday, consists in the incessant marriage of both." (Tyndall).

Faraday said "We may be sure of facts, but our interpretation of facts we should doubt. He is the wisest philosopher who holds his theory with some doubt." His speculation on the nature of matter and on physical lines of force show the way he let his imagination work when he thought it was "time to speculate". De la Rive wrote to him "your intellectual operations supply a striking proof of the value of a vivid imagination in a philosopher."

Tyndall says "The great experimentalist must ever be the habitual theorist, whether or not he gives to his theories formal enunciation." "Though the force of Faraday's imagination was enormous, he bridled it like a mighty rider, and never permitted his intellect to be overthrown."

Faraday wrote to a friend "Keep your imagination within bounds, taking heed lest it run away with your judgment." He speaks of "one of those impressions upon the mind which

are allowable for a time as guides to thought and research. He who labors in experimental inquiries knows how numerous these are and how often their apparent fitness and beauty vanish before the progress and development of real natural truth."

Faraday won his greatest achievement, the discovery of magneto-electricity, by this method. Tyndall says "this is the greatest experimental result ever obtained by an investigator. It is the Mt. Blanc of Faraday's own achievements. He always worked at great elevations, but a higher than this he never subsequently attained."

After Faraday's death A. de la Rive wrote: "I do not think that Faraday has once been caught in a mistake, so precise and conscientious was his mode of experimenting and observing."

In 1853 tables took to spinning mysteriously under the fingers of ladies and gentlemen. Much was said about a new force in nature; much too about strange revelations from another sphere. Some thought it was "satanic action." Many persons inquired of Faraday about the matter. He made a few simple experiments by putting rollers under the fingers of those who were to turn the tables, thus showing how easily the uneducated judgment can be misled by the senses; and how hard it is to shun errors in the interpretation of facts. "Mrs. Browning was so dominated by the superstition that she denounced Faraday in singularly acrimonious terms, and taunted him for shallow materialism." (A materialist is one who hesitates to believe the unbelievable and a shallow materialist is one who furnishes irrefutable facts which point the way of escape from error).

These persons at length roused the meek and gentle Faraday to anger and he broke forth in these words: "What a weak, credulous, incredulous, unbelieving, superstitious, bold, frightened, what a ridiculous world ours is. I should prefer the mind of a dog to that of the average man. Educated man lowers himself below the creatures endowed only with instincts, and in his credulous folly pretends to investigate phenomena with gross ignorance under the mask of scientific knowledge. The world is running mad after the strangest imaginations that can enter the human mind. I cannot help thinking that the delusions of mind, and the credulity which makes many think that supernatural works are wrought where all is either fancy

or knavery, are related to unclean spirits." Controversy whether in religion or science was to Faraday detestable, and these "Spiritualists" enjoy the distinction of being the only persons who ever aroused him to enter the lists.

Faraday's charity and passion to be of service to humanity is everywhere apparent in his life, as witness these words of his: "It certainly has astonished me to see how beautifully and how wonderfully shines forth among nations at large the desire to do good." "There is no part of my life which gives me more delight than my connection with the government lighthouse service." He served his country for nearly thirty years, testing lights for lighthouses and this service he continued to perform until nearly the end of life. He was not at all disposed to underrate the useful applications of science.

Faraday had little use for formal mathematics, but was nevertheless in essence a great mathematician. He said "It is quite comfortable to me to find that experiment need not quail before mathematics, but is quite competent to rival it in discovery."

Liebig said "I have heard mathematical physicists deplore that Faraday's records of his labors were difficult to read or understand; that they often resembled rather abstracts from a diary. But the fault was theirs, not Faraday's. To physicists who have approached physics by the road of chemistry, Faraday's memoirs sound like admirably beautiful music."

Von Helmholtz said "It is in the highest degree astonishing to see what a large number of general theorems he found by a kind of intuition, with the security of instinct, without the help of a single mathematical formula." "With a quite wonderful sagacity and intellectual precision, Faraday performed in his brain the work of a great mathematician without using a single mathematical formula."

Maxwell said "Mathematicians who have rejected Faraday's method of stating laws as unworthy of the precision of their science, have never succeeded in devising any essentially different formulas which shall fully express the phenomena. No exception to the statement of these laws as given by Faraday has been discovered, no new law has been added to them, and Faraday's original statement remains to this day the only one which asserts no more than can be verified by experiment, and

the only one by which the theory of the phenomena can be expressed in a manner which is exactly and numerically accurate." "The way in which Faraday made use of his lines of force in coordinating the phenomena of electric induction shows him to have been a mathematician of high order, and one from whom the mathematicians of the future may derive valuable and fertile methods."

The diversity of Faraday's interests and the magnitude of his labors are shown in the following list of his researches:

Chlorine and chlorides of carbon
Benzol, butylene, solution of naphthalene in sulphuric acid
Diffusion of gases
Liquifaction of gases
Alloys of steel
Optical glass
Velocity of electric spark
Prevention of dry rot in timber
Caoutchouc
Ventilation of coal mines
Lighthouses
Light, heat, and electricity are modifications of one great universal principle
Purifying water by freezing
Allotropism
Artificial stone
The induction of electric currents and the evolution of electricity from magnetism
Terrestrial magneto-electric induction
The identities of electricity from different sources
Conducting power
Electro-chemical decomposition
The source of power in the voltaic pile
The induction of a current on itself
Static induction
The nature of the electric force or forces and the character of the electric force in the gymnotus
The electricity evolved by friction of steam
The magnetization of light and the illumination of magnetic lines of force
New magnetic actions and the magnetic condition of all matter

The crystalline polarity of bismuth and its relation to the magnetic form of force
The possible relation of gravity to electricity
Diamagnetism
Atmospheric magnetism
The lines of magnetic force and the employment of induced magneto-electric currents as their test and measure
Magne-crystallic action
Specific inductive capacity—Theory of contiguous particles
Magnetism of flames and gases
Nature of matter—Lines of force

Professor Reiss of Berlin said "What a wonderful work these researches are in every respect! Incomparable for exhibiting the greatest progresses for which science ever was indebted to the genius of a single philosopher, highly instructive by indicating the means whereby the great results were found—the object of my continual study and admiration."

Within sixteen years from the time he came to the Royal Institution to be Davy's bottle washer, he had published sixty original papers.

What evidence is there for the idea that to succeed one must concentrate along special, narrow lines? Even if some must make the sacrifice for the sake of a certain piece of research, what has that to do with teaching and particularly with high-school teaching?

Faraday received ninety-seven diplomas and distinctions and declined enough to carry the list far above a hundred. Without any formal education, he received L.L.D. from Cambridge University, and D.C.L. from Oxford. He was made Senator of London University and member of a committee to establish degrees in science. He declined professorships in University College and in the University of Edinburgh, and declined to be an examiner in the University. He received scientific honors from almost every academy and university in Europe. He was made Commandant of the Legion of Honor, Chevalier of the Prussian Order of Merit, Knight Commander of the Order of St. Maurice and St. Lazarus. He received numerous medals and the title F. R. S. He declined the presidency of the Royal Institution, declined the presidency of the Royal Society and

declined Knighthood. To honor him Queen Victoria gave him a house on Hampton Court Green, and the King gave him a pension for life. Probably few men have ever received so many scientific honors.

Faraday like Darwin lived very much apart from the world, mingled not at all in society and attended very few public meetings even of scientific men. He had a few very close friends in various countries, with some of whom he kept up a constant correspondence. He wrote all his letters with his own hand. Among his acquaintances may be mentioned beside Davy and Tyndall and those at the Royal Institution and the Royal Society, Ampere, Arago, Becquerel, Biot, De la Rive, Dumas, Du Bois-Reymond, Fresnel, Gay-Lussac, Humboldt, Laplace, Oersted, and Volta, and the painters Turner, Landseer and Stanfield.

In his testimony before the Public School Commission Faraday said: "That the natural knowledge which has been given to the world in such abundance should remain untouched and that no sufficient attempt should be made to convey it to the young mind growing up is to me a matter so strange that I find it difficult to understand." "Highly educated men ask the most simple questions in chemistry or mechanics. Many of these instructed persons are as far from having the power of judging of these things as if their minds had never been trained." He thinks that the study of science is so glorious a school for the mind that school children should spend more than one-fifth of their time in it and that eleven years of age is not too young to begin. "At my Juvenal Lectures at Christmas time" he says "I have never found a child too young to understand intelligently what I told him; they came to me afterward with questions which proved their capability." What sort of science Faraday gave these children may be learned from the two courses which are in print, one on the Chemical History of a Candle and the other on the Forces of Nature. That the children appreciated these lectures is attested by the fact that they attended them in goodly numbers each Christmas week for nineteen years, as given by Faraday at the Royal Institution and they are still attending them, at the Royal Institution given by others. He lectured on such subjects as *A Fire; A Candle*; *A Lamp*; *A Chimney*; *A Kettle*; *Ashes*, etc. He not only believed in teaching science, but *general* science and that

by the project method. Those who attended his lectures said: "In lecturing to children he never allowed his ideas to outrun their intelligence. He took great delight in talking to them, and easily won their confidence. His quick sympathies put him so closely in relation with the child that he saw with the boy's new wonder, and looked as if he had never seen the thing before." He sometimes prepared more than eighty experiments for a single lecture. He said "The eye is superior to the ear for conveying ideas to the mind, hence the value of apparatus, experiments, diagrams, tables, etc."

Faraday believed in teaching adults also by lectures, hence in 1826 he began the famous Friday evening lectures at the Royal Institution with the avowed purpose of "making science attractive to the world." He said "Science is undeniably most eminent in its fitness for the purpose of lectures. There is no part of it that may not be treated, illustrated, and explained with profit and pleasure to the hearers in this manner. The facility with which it allows of experimental illustration places it foremost. After it comes arts, manufacturers, the polite arts, belles lettres, and a list which may be extended until it includes almost every thought and idea in the mind of man. Let the subject fit the audience, or otherwise success may be despaired of." Faraday understood the value of novelty and made much use of the spectacular in his lectures, saying, "there is nothing more strange in the human mind than the manner in which a little familiarity in thought reduces the highest and the most important of truths to the dull no-interest of every day commonplace."

Faraday trained himself to speak slowly in lecturing and instinctively knew how to time his utterances to the echoes of the theatre. He frequently had a card lying on the lecture table before him with the word *slow* written upon it. His lectures were always crowded and were attended by all classes, the King being frequently present. It is said "He had the art of making philosophy charming—No attentive listener ever came away from one of Faraday's lectures without having the limits of his spiritual vision enlarged, or without feeling that his imagination had been stimulated to something beyond the mere expression of physical facts."

Mrs. Richard Owen said "Faraday is the *beau ideal* of a popular lecturer. He made us laugh heartily, and when he threw a coal scuttle full of coals, a poker, and a pair of tongs at the great magnet, and they stuck there, the theatre echoed with shouts of laughter."

De la Rive said "Nothing can give a notion of the charm which he imparted to these lectures. He knew how to combine animated, and often eloquent, language with a judgment and art in his experiments which added to the clearness and elegance of his exposition. He exerted an actual fascination upon his auditors; and when, after having initiated them into the mysteries of science, he terminated his lecture, as he was in the habit of doing, by rising into regions far above matter, space, and time, the emotion which he experienced did not fail to communicate itself to those who listened to him, and their enthusiasm had no longer any bounds." His last Friday evening lecture was given on June 20, 1862.

Faraday was deeply religious. Of revivals, however, he said "any power they may have over one's mind must be a delusion and a snare. He who learns from the Scriptures needs no crowd and no revival to teach him."

John Tyndall after dining with Faraday wrote: "He said Grace in the language of Scripture. It might be described as the petition of a son into whose heart God had sent the Spirit of His Son, and who with absolute trust asked a blessing from his father. I love strength, but let me not forget the example of its union with modesty, tenderness and sweetness in the character of Faraday."

J. H. Gladstone says: "There are persons now living who watched this man of strong will and intense feelings raising himself from the lower ranks of society, yet without losing his balance; rather growing in simplicity, disinterestedness, and humility as princes became his correspondents, and all the learned bodies of the world vied with each other to do him homage; still finding his greatest happiness at home, though reigning in the affections of all his fellows."

"He was very happy in his position and with his pursuits, which elevated him entirely out of the meaner aspects and lower aims of common life." "His sensitive and enthusiastic temperament had much in common with that of the artist, and he enjoyed music, especially good music, greatly."

"This son of a blacksmith and apprentice to a bookbinder, had to decide between a fortune of say three-quarters of a million dollars on the one side, and his undowered science on the other. He chose the latter, and died a poor man. But his was the glory of holding aloft among the nations the scientific name of England for a period of forty years."

Faraday deliberately gave up an annual income of more than $6000 for $1000 and time to think, saying "I have always loved science more than money. I cannot afford to get rich."

M. Dumas' eulogy of Faraday at the French Academy of Sciences contains the following: "I have never known a man more worthy of being loved, of being admired, of being mourned. There is more than one useful lesson to be learned from the proper study of this illustrious man, whose youth endured poverty with dignity, whose mature age bore honors with moderation, and whose last years have passed away surrounded by marks of respect and tender affection."

"That one who had been a newspaper boy should receive unsought almost every honor which every republic of science throughout the world could give; that he should for many years be consulted constantly by the different departments of the Government, and other authorities on questions regarding the good of others; that he should be sought after by the princes of his own and of other countries; and that he should be the admiration of every scientific or unscientific person who knew anything of him, was enough to have made him proud, but the Faraday who delivered newspapers at private houses, the Faraday that begged for the meanest place in a scientific workshop and the Faraday that declined the highest honors which British science could offer was always the same meek and humble Faraday."

Near the close of his life Faraday wrote: "My worldly faculties are slipping away day by day. Happy is it for all of us that the true good lies not in them. As they ebb, may they leave us as little children trusting in the Father of mercies and accepting His unspeakable gift."

He died August 25, 1867, and Gladstone said: "There was a philosopher less on earth and a saint more in heaven."

Preparation of Teachers of Sex-Education or Social Hygiene Education[1]

M. A. Bigelow, Teachers College, Columbia University.

The first step in the preparation of teachers of sex-education consists in understanding what is to be taught and why it should be taught. Hence, I shall begin with these sub-topics.

Social-hygiene has come into American usage within the past fifteen years to include all problems of the racial or sex-instinct which, while a function of individual life, is chiefly concerned with the relations of individuals in social groups, particularly in that fundamental unit of sex-relationship which we call the family. In short, social-hygiene as now understood involves all the relations of sex as they concern all social groups of two or more individuals. The task or aim of social-hygiene is to make progressively better all sex-relationships in human life to the end that life itself may be better.

Social-hygiene means much more than the older phrase sex-hygiene, which was unpopular because that little word "sex" is so commonly misunderstood by otherwise intelligent people. For the purpose of this science conference, let us begin by getting a clear understanding of the meaning of sex. Briefly, it is this: (1) Biologically and originally a provision for double parentage, for perpetuation of life by two cooperating individuals of a pair, known as male and female, (2) of the original provision for reproduction of new individuals by two cooperating individuals there has developed in human life, but in no other living things, physical or spiritual love with all its splendid possibilities as found in ideal family life; in other words, out of the material aspects of reproduction, as illustrated by the animals and plants, have evolved the possibilities of the conjugal affection of parents for each other, of their parental affection for their offspring, and probably the filial affection of offspring for their parents. In short, all the phases of affection in ideal family life have their basis in sex instincts which originally were merely a controlling force for the physical mechanism of reproduction, (3) finally, sex has led upward to social and intellectual comradeship of men and women who meet on terms practically independent of the origi-

[1] Paper read at New Jersey Science Teachers Association, Nov. 1, 1919.

nal or biological meaning of sex. It is this three-phase interpretation of sex meaning and outlook which should be clearly grasped by those who prepare to give sex-instruction.

In addition to understanding the meaning of sex, teachers and parents should know the outlines of the national social-hygiene campaign carried on for many years by the American Social Hygiene Association, and was made an official national movement by an act of Congress in July 1918.

The most prominent part of the social-hygiene movement up to a recent date is a direct health drive against venereal diseases which owe their continued existence to immorality (by which we mean sexual union outside of approved marriage). Indirectly, the attack on venereal diseases involves other problems of social-hygiene, especially those of social relationships and morals and vulgar attitude. Since physical health is being stressed, the direction of the official campaign is in the United States Public Health Service, for which Congress has appropriated about $4,000,000 to be used within two years, partly in cooperation with State Boards of Health. The reason for such emphasis on the diseases resulting from social vice is that the war has taught us the vast importance of this problem, because compulsory medical examinations have given a fairly accurate estimate of the amount of disease among young men from twenty-one to thirty-one selected by the draft rules, and therefore giving a fairly scientific representation of this age group. Of course, nothing has been accurately estimated concerning women or men of other ages.

The campaign against venereal disease is of great importance, but standing alone it is adequate only for solution of social health problems. The other sex problems should be attacked coincidently and some of them will react to help in the fight against venereal disease. Educators especially should bear in mind that venereal disease is only one of several serious sex problems of our times. (Read Chapter II in "Sex-Education.")

The mental and social problems of maladjustments of sexual life are the real causes of sexual promiscuity which, in turn, is responsible on the one hand for distribution of venereal dis-

eases and, on the other, for social consequences of greatest significance to the monogamic family and civilization.

Towards the solution of these problems, organized sex-education offers the only hopeful constructive program, for sex-education (social-hygiene education) aims to teach and influence young people of the character-forming years so that they will be prepared to face physical, mental, and social problems in which the sexual instinct influences human life.

A third big thought for teachers and parents is that the greatest constructive work of the future must be educational, leading towards mental, moral, and social problems phylaxis that will prevent for vast numbers of individuals the sexual disharmonies which now disturb the physical and social life. Now, educational work that is to touch moral and social life must be habit-forming and character-moulding. This means that it is a work chiefly for pre-adolescent and early adolescent years. Our wartime experience in social-hygiene education leads many workers in sex-education to doubt whether it was of any great value as moral education so far as it reached mature men and women. I mean that we doubt whether sex character was modified; but, of course, I recognize that sex-conduct was influenced in thousands of cases. Certainly, society always gains by such improved sex-conduct even if it is brought about by teaching concerning sanitary or social or religious penalties. Likewise, laws against murder reduce crime by affecting the conduct of would-be criminals, but they do not improve their moral nature. However, society at large gains, no matter whether crime is prevented by moral or character teaching in home or school or by laws prescribing deterrent penalties.

It is generally agreed among thinking citizens that society can not afford to continue control of crime and other unsocial conduct merely by setting up penalties (such as fear of imprisonment and fear of contracting disease) for those who break civil and social and moral laws. We need something more fundamental and more constructive, and so we are turning to social and moral education. It follows that since the problems of sex turn on the individual's conduct as it concerns society or a social group consisting of one or more other individuals, we should begin moral or social instruction concerning sex life

while character and attitude towards life problems are being developed, especially in the first fifteen years of life.

Having pointed out in general outlines the main bearings of social-hygiene as, I think, teachers and parents should know them, I propose to consider for a few minutes (a) the child's first teachers, (b) teachers in general, (c) special group teachers for classes in schools or other institutions.

(a) The first teachers should be parents or other adults who are on the most intimate terms with the child, the adults with greatest personal influence. With children of pre-adolescent years, sex of the teacher need not be considered. Mother, father or teacher may deal the same with children of both sexes up to the beginning of adolescence. Lucky are those children whose parents hold their intimate confidence far into and even through adolescence. The child's first teachers should know a few simple facts, such as the life histories of some common plants and animals as taught by good nature-study teachers. The children should learn, for the sake of attitude, how life begins in lower animals (e. g.,) insects, fishes, frogs, or toads, birds, rabbits, cats, or other mammal. Many teachers prefer to begin with plants, but lower animals are better. Not much technical knowledge is needed. Books will help prepare for teaching pre-adolescent children. Hodge, "N. S."; Holts, "N. S."; Comstock, "Handbook of Nature-Study"; March, "Racial Health"; Cady, "The Way Life Begins"; Morley, "Renewal of Life"; W. S. Hall, "The Doctor's Daughter." There should be no books except nature-study for the pre-adolescent sex-instruction of children. Such books as named above are for the parents and other teachers. In addition to such mature knowledge, they should know something of the pre-adolescent sex life of children. They must not forget that the average boy gathers sexual information, often extensive, one to seven years before he is twelve years of age. The average girl is much more protected. However, direct dealing with the boy is possible. Especially should the child's teachers aim to keep intimacy and be ready to counteract vulgarity. Then, there is the personal sex-hygiene problem; see pp. 137-145 of my "Sex-Education."

(b) Teachers in general—All teachers in regular schools

and church schools should understand and be prepared to help young people by personal advice and, above all, by the wholesome attitude towards sex. In fact, all intelligent adults should be ready to help with the problem.

(c) Class teachers for schools, colleges, Y. M. C. A., Y. W. C. A., churches, etc. These should be teachers of the scientific facts, of sex physiology, sex-hygiene, and sex-ethics. See Chapter III in my "Sex-Education." Impersonal approach. Specially prepared teachers required, but no sex-specialists. There must be specially selected teachers for culminating work of sex-instruction. In selecting teachers, avoid five types of undesirables: (1) embarrassed teachers who can not speak calmly, seriously, and without great embarrassment. (2) The psycho-pathic teachers, who are radical and devoted to Freud, Kraft-Ebbing, Ellis, Bloch and Moll. It is unwise to trust American young people with followers of such authors. Too much psycho-pathology of sex is circulating already among half-baked enthusiasts who lack foundation in normal physiology and psychology. (3) Those who emphasize perverted life and vice. The less the average teacher knows about psycho-pathological cases and vice reports, the better. It is not necessary to know much in this line in order to warn the young. (4) Sexual pessimists. Some are due to personal failure in romance or marriage, some to knowledge of vice conditions. There are many such women and some men in our schools and colleges. Hopeless philosophy of sex should not be taught to young people, but rather emphasize the optimistic. (5) Teachers who are not respected by pupils, because they have a flippant attitude, vulgarity, and doubtful character.

Avoid these five types. Select perfectly normal, wholesome, optimistic, hopeful, serious men and women. Omit special sex-hygiene and sex-ethics rather than intrust such teaching to one of the above types.

Having rejected the undesirable and selected the promising teachers, they should prepare especially for teaching sex-hygiene and sex-ethics.

For teaching sex-hygiene, the need of general knowledge of normal personal sex-hygiene, but not much concerning venereal diseases (see page 41 in "Sex-Education"). No venereal disease statistics are useful to young people. For teaching sex-ethics, the teacher needs a strong belief in the monogamic ideal

of morality, the prevailing American ideal, even though some people do not live up to their ideal. Young people need more clear thinking on monogamic marriage.

Along such lines, parent teachers and other teachers must prepare to teach young people how to face and solve the problems of sex. It is not a work soon to be completed. Each succeeding generation of young people must face the same old problems of life.. The parent-teacher and other teachers must remember that sex-education can help only by giving the individual a basis for choice between the good and the evil of sexuality. Hence, as teachers we must guide young people to see and choose the best and to avoid the evil in the sexual sphere of life. In short, the duty of all who teach young people concerning sex is to make scientific, social and ethical knowledge and personal influence help young people of each generation to choose successfully between sexual evil and sexual good.

Shall Science Teaching Be Curtailed?

RESOLUTIONS PASSED BY THE NEW JERSEY SCIENCE TEACHERS ASSOCIATION.

In Convention at New Brunswick, Nov. 1, 1919.

Whereas, present educational tendencies, particularly the making of science courses elective, and the adding of so much required work in history and civics, threaten to cripple to the extent of actual disaster the work of science teaching in secondary schools, and

Since, the war has so firmly established the tremendous value in national service of even an elementary scientific training, as well as the close connection between such training and patriotic service, be it

Resolved: That the following recommendations express the attitude of the New Jersey Science Teachers' Association on this subject:

First: That we appeal to those in authority in colleges and other higher institutions which customarily accept our graduates to give recognition to our science courses by providing separate classes for those students who have had a year of preparation in the subject and those who have not.

Also, that other science courses as well as physics, chemistry and biology, if based upon a quantity and standard of work which is the full equivalent of these courses, be given entrance credit on the usual basis.

Second: That we appeal to principals and superintendents of secondary schools to plan their curricula so that at least two units of science (a unit consisting of a regular course in a subject, five times a week for one year), shall be necessary for graduation from any department of the high school except the commercial department where one such unit of science may suffice.

That students taking the scientific curriculum should be urged to take at least three units of science for graduation.

That the familiar practice of directing the so-called "hand-minded" students and students of mentality below standard, into the science courses should be discontinued and that the more intelligent, or students of the average type be encouraged to take scientific training—at least to such a degree that the average mentality of pupils in the science curriculum shall be as high as the average of the whole school.

Third: That we appeal to the Commissioner of Education and his associates at Trenton to make such provision that graduation from a first-class high school accredited by the state shall require a minimum of two units of scientific training, except in the distinctively commercial department.

Fourth: That every member of the New Jersey Science Teachers' Association be urged to take to heart the present crisis in their profession and to do all in their power to secure the effectiveness of such conditions as are outlined above; and further, be it

Resolved: That the secretary of the Association is authorized to have printed and to mail properly marked copies of these resolutions to the following persons: the officials of those colleges which commonly accept our graduates; all principals and superintendents of high schools in the state; the Commissioner of Education and his associates, and, as far as possible, other science teachers in the state.

M. C. LEONARD, Pres.

Dickinson High School, Jersey City.

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